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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

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TROPICAL AGRICULTURE is published monthly at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies. Advertisement and subscription rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed or recommendations made in signed articles or in articles of which the source is named are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from the various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

THE NEW SESSION, 1934-35.

THE opening of the new College session has been accompanied, as in previous years, by various changes of general interest which may briefly be recorded here. We should like in the first instance to welcome back the Carnegie Professor of Economics who has just returned from an extensive tour of the Gold Coast, Nigeria and Sierra Leone. Mr. A. W. Paterson, who acted as Professor of Economics, has in the meantime resumed his duties with the Gold Coast Department of Agriculture. During his short term of office in Trinidad, he became a deservedly popular member of our staff and we take this opportunity of wishing him all success in the continuation of his career in the Gold Coast. Reference must, in passing, be made to this exchange of officers, the results of which, we hope, may pave the way for further exchanges. In this particular case Professor Shephard has not only been able to collect a great deal of firsthand information, but has also established valuable contacts with the West African Colonies concerned, while Mr. Paterson has had an exceptional opportunity of making himself thoroughly acquainted with the activities of this Institution. In view of the valuable experience which both officers have gained, there appears to be no reason why the system should not be extended in future to other members of the College staff as well as to other colonies. The matter is an important one and we hope that it will receive the consideration that it deserves. An officer whom we shall miss is Mr. A. K. Briant who first joined the College in 1928 as Lecturer in Mycology and who was last year appointed Assistant to the Commissioner of Agriculture. We take this opportunity of extending him our best wishes in his new sphere of activities as Superintendent of Agriculture in St. Vincent. We regret also to report the departure for Malta of Mr. A. C. Shill who rendered as Marketing Officer especially valuable services in the development of the fruit and vegetable industries of the Windward and Leeward Islands.

Turning to the teaching side of our activities we are able to record that the number of students attending the Diploma Course has been more than maintained. Of these students 25 come from the West Indies and British Guiana, one from Colombia, one from Martinique and one from England. There are at present, in residence, five more Diploma students than last year. There has, on the other hand, been a reduction in the number of Colonial Office Scholars. This was to

be anticipated in view of the lack of vacancies during recent years in the Colonial Agricultural Services. There are already signs, however, that this state of affairs is not likely to continue as we understand that certain Colonial Departments of Agriculture will shortly be taking steps to strengthen their staffs which have been severely depleted during the prevailing depression. It is anticipated that there will be one, if not two, more Indian Government students who will be specialising in sugar technology under the scholarship scheme announced last year. In regard to students following special courses, facilities have been granted to a member of the staff of the Antigua Department of Agriculture for taking a short refresher course at the College. Last year the same facilities for training were extended to a member of the Dominica Department of Agriculture. In addition, a student attached to the staff of the Usine Ste. Madeleine will be taking a special course in Sugar Technology.

In the sphere of research it is becoming clearer every year that the College is being used more and more by various bodies as a centre for conducting certain lines of research. In this connection it may be mentioned that most of the laboratory work, chemical and entomological, in connection with the Trinidad Sugar-Cane Investigation Committee's activities which are financed by local sugar plantations and the Trinidad Government, is being carried out at the College. The headquarters of the advisory officers in charge of this work and of the work of the Antigua and St. Kitts Sugar-Cane Investigation Committees are, moreover, also situated at the College. Similarly, this institution has been entrusted by certain colonies and British firms with a scheme for cacao research while Imperial Chemical Industries has also been afforded special facilities for carrying out various manurial experiments. There is a good deal to be said for the College being in a position to place its facilities for research in the manner indicated and we shall watch with interest further developments in this direction.

Whenever possible, close relations are being maintained between College Departments and research institutions working on similar problems elsewhere. For instance the work of the Low Temperature Station is being kept in close touch with that of the Cambridge Low Temperature Station. A similar object has been achieved by permitting members of the research staffs of other institutions to use the College as their headquarters for carrying out investigations into problems which can only be studied in a tropical environment. In this connection, it will be remembered that the London School of Hygiene and Tropical Medicine recently made full use of these facilities. During the coming session arrangements have been made to allow a research student from Harvard to pursue certain investigations on fungus growing ants. The College undoubtedly offers exceptional opportunities as a centre for this type of research.

The new session shows every prospect of being a successful one. The financial position of the College has been consolidated in so far as the Imperial Government has promised to continue the grant which originally was paid by the Empire Marketing Board. On the other hand, it will be remembered that the original grant from this body was cut down by ten per cent. three years ago. There has, moreover, been also a regrettable tendency during the crisis to reduce grants from other regular sources of revenue. Now that economic conditions are generally showing signs of improvement it is to be hoped that an opportunity will be taken to restore these grants to their original proportions. The activities of the College have been maintained with considerable difficulty during the past three years and since its aims and objects are continually increasing, as more work and additional responsibilities are undertaken, the need for increased revenue is obvious.

OBITUARY.

LADY WATTS.

With deep regret we have to record the death of Lady Watts, widow of the first Principal of the College, at her home in St. Augustine on 4th October.

Lady Watts was a woman with a genius for friendship, and there can be scarcely a Colony of the Empire in which the news of her passing does not carry to somebody a sense of personal loss. We might write in appreciation of her vigorous personality, triumphant over physical limitation; of her ready wit and robust sense of humour, often harmlessly mischievous but never unkind; of her devotion to Sir Francis, his life's work and his memory, her staunch loyalty to her friends, or of much else that was admirable in her. But everyone privileged to know her will think first of her lively interest in the welfare and pleasure of others. Sickness or sorrow indeed called forth instant proof of her practical sympathy as soon as she knew of it, and furthermore she took pains to be kept informed. With Lady Watts, however, sympathy was less a matter of mere condolence than a positive contribution to the sum of happiness in the world, and it shone brightly in the evident and sincere delight she derived from seeing other people, especially younger people, enjoying themselves. In ensuring pleasure to those about her, she was unsparing of herself, as was shown, to take only one example, by the energy devoted to the success of her popular monthly "At Homes", continued in a succession of West Indian islands over a long period of years.

The death of Sir Francis Watts, just four years ago, was a terrible blow to his widow, and the state of her health caused increasing anxiety to her family and friends from that time on. Now a very gallant soul has gone to the rest she began to desire, and in extending our sympathy to her sons and daughters, widely separated in various parts of the world, we share with gratitude a memory that will be their pride.

FIELD OBSERVATIONS ON SOME GUIANA INSECTS OF MEDICAL AND VETERINARY INTEREST.

By J. G. Myers, sc.d., f.r.e.s., f.z.s.,

Imperial Institute of Entomology and Imperial College of Tropical Agriculture.

Introduction.

In the course of a number of journeys in the interior of northern South America, in the search for new natural enemies of plant-pests, I was inspired by Professor P. A. Buxton, of the London School of Hygiene and Tropical Medicine, to collect for him incidentally a few insects of medical interest. This was the more easy since they were attracted not only to ourselves but also to our Indian carriers, our horses and pack-bullocks. The material was determined by the Imperial Institute of Entomology, to whom it was submitted by Dr. Buxton. I am indebted to Dr. Buxton for the interest he has taken in these often scrappy collections. He is not responsible for any opinions expressed below. In order to avoid a longer or a more indefinite geographical title I have used the term "Guiana" in its widest sense to include the area between the Orinoco, the Atlantic coast, the lower Amazon and the Amazon-Orinoco watershed. This is strictly correct, since both Venezuela and Brazil recognise Guiana provinces, making two additional to the three owned by European powers.

"Eye-flies."

In most tropical countries there exist, in addition to hordes of biting and sucking insects, some few—few, that is, in species, but legion as to individuals—which, though they neither sting nor bite, are an especial source of torment and pain from their persistent habit of entering the eyes. Some are worse for their numbers and endless persistence, others for the acute pain produced by their secretions. Buxton found a species of *Sarcophaga* addicted to this habit in Samoa, while the writer suffered in Central Australia from the similar attentions of a small bush-fly, *Musca vetustissima*, related to the house-fly. In the area under consideration there are four main types, only two of which are true flies, the others being stingless bees (*Trigona*) and a small Heteropterous bug (*Amnestus*).

Hippelates is a genus of small blackish Oscinid flies widely distributed in North and South America and the West Indies. In the Rupununi and Rio Branco savannahs a species is in places almost intolerable, but its distribution is curiously restricted, the chief limiting factor being wind. The greater part of this large savannah region is swept by an almost constant prevailing wind, from the north-east, and it is only in the lee of such mountains as the Kanukus, or on small savannahs surrounded by forest that it is abundant and troublesome. Occasionally in the high woods, for instance at the base of the Kanukus, small Indian provision-fields, and the banks of sheltered creeks are heavily infested. In the latter situations it combines with the kaboura fly or *piúm* (*Simulium* spp.)* to make life unbearable.

The other fly is a small grey Anthomyiid, which, although not so specialised and persistent as *Hippelates* and *Trigona* in its attacks on the eyes, is still at times, an almost intolerable nuisance, especially when associated with the former and with *Simulium*, as it was in the three localities in which I encountered it. These places were well-sheltered, forested creek-beds, two on the Uraricuera-Cotinga savannahs at about 2,000 feet (December, 1932) and one in virgin lowland forest at the base of the Kanuku Mountains (Napi Creek, January, 1934).

The *Trigona* (probably more than one species) is a minute stingless bee, actually one of the smallest bees in the world. It is stronger and even more persistent than *Hippelates*, and causes much greater pain than the latter, when inside the eye, owing to its harder texture, greater resistance and size. It is particularly abundant both on the Rupununi savannahs and the upper campos of the Rio Branco, where abrupt rocky mountains, clothed with low, dry, semi-deciduous forest rise abruptly from the plains (*e.g.* Shiriri mountain, and Serra de Anáru). On the lee side and base of such hills, camps in the dry season are rendered almost uninhabitable by these bees, unless one employs heavy smudge-fires or mosquito nets. In the case of these bees, the surroundings are so dry, and water so scarce, that moisture is probably the main attraction to one's eyes, but this will not explain the behaviour of *Hippelates* in moist rain-forest clearings. Both the flies and the bees also lick perspiration greedily.

The fourth "eye-fly", which occurs also in Trinidad, and is known there very appropriately as "pepper-fly" belongs to another category, in that its entrance into one's eyes seems to be largely accidental. At least it is fortunately

* There are very marked restrictions in the altitudinal and vegetational distribution of these flies, but as the species are not yet determined I reserve further details. The association between *Hippelates* and *Simulium* is sometimes quite close. Thus, at Marutuaka I observed a small *Simulium* biting my wrist when a *Hippelates* arrived and pushed the biting fly vigorously with its head, thrust out its proboscis and tried to suck the edge of the wound occupied by the mouth-parts of the biter. It pushed again and again, forcing the *Simulium*, pivoted on its bite, round nearly in a circle. Finally it burrowed under the latter, and pushed till the *Simulium* stood on its head, and finally flew away, with its feed uncompleted. The *Hippelates* at once rushed to the vacated puncture. It had taken no notice of the droplets of clear fluid which the *Simulium* emitted, from time to time, from its anus.

not so persistent nor so abundant as the others. It is a stoutly-built though tiny, shining brown bug (*Amnestus* sp.), which during its struggles in one's eye, liberates a secretion, the effects of which can only be compared to that of Cayenne pepper. The agony, moreover, endures for several hours after the removal of the insect.

Myiasis caused by *Cochliomyia*.

Cochliomyia macellaria is the most abundant blow-fly of the region, often attracted in great numbers to carrion and to forest camps. On the Barima River, British Guiana, North-west District, it was, for instance, present in swarms at a semi-permanent camp of Carib timber-cutters, where it settled in large numbers on one's food, needing a switch in constant employment. In a similar rain-forest camp on the Coppename River in Dutch Guiana in April, 1929, when constant rain and excessive humidity made it almost impossible to dry one's garments, a pair of heavy woollen socks were so thickly interpenetrated with eggs that they had to be thrown away. Páez (1929, p. 249) records that on the Venezuelan llanos, during the rains, when it was impossible to keep dry the spare clothes and blankets, these became in a few hours, covered with myriads of fly maggots.

In the Rupununi savannahs one of the most troublesome affections of stock, especially in the wet season, is fly-blow or "bicheiro". It attacks branding sores, castration cuts, and other wounds, and follows on severe ear-tick (*Dermacentor nitens*) infestation. I ascribed this to the same fly, *Cochliomyia macellaria*, but Professor Buxton informs me that a new species, *C. americana* Cushing and Patton, only distinguishable with the greatest difficulty, has been shown to be responsible in North America for myiasis usually attributed to the older species. Flies reared by me from a deep wound in the thigh of a bullock, on the Ichilibar Savannah, Pakaraima Mountains, were similarly identified as *C. americana*. Incidentally the Macusi Indian cowboy, after gouging out the larvae with a finger, plugged the wound with pounded tannia (root of the edible Aroid, *Xanthosoma* sp.) and plastered it with fresh cowdung. The usual dressing on the Rupununi savannahs is a mixture of creolin and lard, which is also employed against the ear-tick.

In the forested sections of the British Guiana Cattle-Trail, *Cochliomyia** was exceedingly troublesome, producing myiasis in wounds caused almost nightly, and often very plentifully, by the bites of vampire bats (*Desmodus* sp.) on our pack-bullocks.

Barrington Brown (1876 p. 371) records a severe case of myiasis in a sloth.

Further study is needed to determine whether *C. macellaria* ever produces myiasis, or whether *C. americana* is always and everywhere the fly responsible.

In the course of blow-fly studies in England, during which large numbers of carrion-feeding Muscoids were reared, it was a practically invariable rule for the flies to emerge from the puparia in the morning. I was therefore surprised to find, on the Uraricuera River in December, 1932, that immense numbers of *C. macellaria* which had developed in the carcase of a dead capybara, were emerging from the puparia in the evening, just before sunset. Cicadas almost always do this. Is it to avoid the risk of the more numerous tropical predators?

The circumscribed ecological distribution of an Anopheline.

In the Rupununi savannahs generally, the wet season is marked by the seething abundance of an Anopheline mosquito, which bites very viciously at night in the open savannah. Specimens from the lower Takutu were determined as *Anopheles bachmani*, but it is by no means certain that this is the predominant species. Unfortunately my other material was destroyed. It is, however, certain that these extremely abundant savannah mosquitoes are exclusively *Anopheles*.

I was at once struck by the fact that whereas on the open savannah, throughout the night, these mosquitoes were intolerable, in several of the ranch houses, only 20 or 30 yards from these myriads, one could sleep without a net. I ascribed this at first to the fact that the houses usually stood on somewhat higher ground, and received more breeze, but the case which I analysed in detail was not subject to this explanation, and the real cause remains a mystery. The house in question was an Indian hut built actually in a low part of the savannah, not far from an aeta palm (*Mauritia flexuosa*) swamp. The house site was not raised in the least. For a considerable distance round the house-clearing grew a practically pure stand of a Malvaceous weed, *Sida* sp., passing gradually into grass (*Trachypogon*) savannah on the higher portions, and into swamp vegetation in the lower. On one side the house was separated from the savannah vegetation by carefully weeded, quite bare ground, some 25 to 30 yards wide. On the other side short swamp grasses and sedges reached the building. Mosquitoes were as good as absent in the house and on this bare ground, but one yard within the *Sida* beds they were present in veritable myriads, which not only bit everywhere fiercely, but entered eyes and nostrils in choking swarms. The Indian and his wife slept without mosquito nets, and we were not bitten during dinner, though we later used our mosquito nets as a matter of routine. Every night the cattle, to the number of 50 or more, congregated from the surrounding savannah; and stood in a packed mass on the patch of bare ground, as

* I assumed it to be *C. macellaria*, which was breeding in incredible numbers in the carcases of numerous bullocks which had died on the trail just before our passage; but in the light of this newer information it was more probably *C. americana*.

near as they could crowd to the house. This, I thought, must be the key to our immunity—the cattle were diverting the mosquito attack from us (*zoöprophylaxis*) as Humboldt first recorded on the Upper Orinoco (*see* Myers, 1932). But investigation with an electric torch proved this conclusion fallacious. The cattle stood contentedly chewing the cud, and so far as I could gather, were not being bitten at all. The only explanation, which would apply to the ranches as well, is that this *Anopheles* is very closely confined to the shelter of the herbage, and does not cross even a few yards of bare ground.

The ecological distribution of some horse-flies (*Tabanidae*).

The distribution of these flies is of economic interest on the savannahs of the Rupununi and the Rio Branco, where stock-raising is the only industry, horses the only means (save foot) of travel, and *mal de caderas* a devastating equine disease, said to be carried by these flies. I had ample opportunities of catching these insects on our carriers, our animals and ourselves, and I was interested to see how closely the different species were restricted to definite plant-associations using the latter term in its widest sense. On the open savannahs, far from forest, Tabanids are scarce, but in small enclosed savannahs, surrounded by forest, such as that of the bush islands and river fringes, huge *Tabanus* spp. (chiefly *T. importunus*) are frequently so abundant and persistent as to drive one's horses nearly crazy.

A detailed description of the plant communities listed below is in course of preparation for publication in an ecological journal.

A.—Savannah Species.

1. *Coastal cane-lands.*
   Tabanus cinerarius, Wied. (Nickerie, Dutch Guiana).
   Tabanus trilineatus, Latr. (Nickerie, Dutch Guiana).
   (Both biting a mule). This species is said to transmit *mal de caderas* in Marajó.
2. *Wide savannah rivers* (*Uraricuera and Takutu*) 300-600 *feet elevation, with fringe forest of varying width.*
   Diachlorus sp. (2) not in B.M. Abundant in boat, fiercely biting legs and feet.
   Chrysops laeta, F. Biting in boat.
   Tabanus comitans, Wied. On savannah bank (gap in fringe forest). Biting man.
3. *Small isolated savannahs in semi-deciducus (monsoon) forest below* 1000 *feet, Pakaraima Mts.*
   Esenbeckia prasiniventris, Macq. Biting horses.
   Tabanus comitans, Wied. Biting horses.
   Tabanus importunus, Wied. Biting horses. This species is said to transmit *mal de caderas* in Marajó.
4. *Upland savannahs, Mount Roraima and district.*
   Diachlorus sp. not in B.M. Common, biting man (3,300, 6,600 feet)
   Tabanus sp. (3) not in B.M. Biting man (3,300, 6,600 feet)

B.—Forest Species.

5. *Swamp forest, Orinoco Delta.*
   Tabanus ? callosus, Macq. Abundant, biting man.
   Tabanus plangens, Walk. Very abundant, biting man.
   Lepidoselaga lepidota, Wied. Frequent. Biting man.
6. *Lowland mixed rain-forest.*
   Tabanus occidentalis, *L.* (North-west District, B. Guiana) Frequent.
   Diachlorus scutellatus, Macq. (N.W. District). Abundant and persistent biter of man.
   Chrysops costata, Fab. (N. W. District). Biting man.
   Tabanus albibarbis, Wied. (N.W. District). Frequent, biting man.
   Tabanus discifer, Walk. (N.W. District).
   Elaphella cervus, Wied. (N.W. District). Frequent, biting man.
   Tabanus leucaspis, Wied. (N.W. District). Biting man.
   Dichelacera marginata, Macq. (Mojú, Pará). Biting man.
   Dichelacera damicornis, F. (Berbice).
7. *Greenheart* (*Nectandra Rodiei*) *lowland rain forest, Cattle-Trail, British Guiana.*
   Tabanus aphanipterus, Wied. Biting horse.
   Dichelacera T-nigrum, F. Biting legs.
8. *Mixed rain-forest* 1,000-2,000 *feet, Pakaraima Mountains.*
   Tabanus scutellatus, Kröb. Abundant. Biting man.
   Tabanus sp. (1) not in B.M. Abundant. Biting man.
   Tabanus sp. (2) not in B.M. Biting man.
   Erephopsis sp. (1) not in B.M.
   Erephopsis sp. (2) not in B.M.
9. *Rain-forest consisting of one species of profusely coppicing Leguminous tree* (probably a *Dicymbe*) 1,000-2,000 *feet, Pakaraima Mts.*
   Tabanus modestus, Wied. Biting man.
10. *Moist mixed rain-forest (in part cloud-forest),* 2,000-3,000 *feet, Pakaraima Mountains.*
   Tabanus scutellatus, Kr b.
   Tabanus sp. (2) not in B.M. Biting man.
   Erephopsis sp. (1) not in B.M. Biting man.
   Erephosis sp. (2) not in B.M. Abundant. Biting man.
   Bolbodimyia bicolor, Big.
   Chrysops frazari, Will. (This species occurs also in lowland mixed rain-forest in Trinidad) Biting man.
   Tabanus modestus, Wied. Biting man.

11. "*Asheroa*" *rain-forest*, 3,000 *feet, Pakaraima Mts.* (*This consists of one species of very tall, strongly-buttressed tree with large, simple coriaceous leaves*).
Chrysops molesta, Wied. Biting man.
Erephopsis sp. (1) not in B.M. Biting man.
Tabanus sp. (2) not in B.M. Biting man.
12. *Mixed rain-forest islands in upland savannah* 3,000-3,500 *feet. Roraima district.*
Chrysops laeta, F. Abundant in two localities, but followed us only a few yards into the open savannah. Biting man badly.

Periodicity in Tabanid behaviour.

Other observers have remarked on the quite circumscribed biting hours of some Tabanid species. Most of those in the above list were annoying throughout the warmer part of the day, especially those which followed our canoes and bit the paddlers. The long beaked ones, notably *Elaphella* and the two *Erephopsis* species, bit only in the dusk, the former only at dawn, and the latter two at dawn and sunset. The rest of the day they were never seen. In the North-west District, where we were working with a gang of Indians in the same locality for an extended period, the succession of biters throughout the day was most marked. *Elaphella* invariably appeared just as the dawn was breaking, flew round the hammock nets and hanging clothes, inserted its long beak through the former, and was a painful annoyance at the bath, where it went especially and persistently for the buttocks. I never saw it after 7 a.m. The larger species of *Tabanus* were the chief biters up till about 10 a.m. They did not disappear then, but their numbers were greatly exceeded by the smaller species of *Tabanus*, which continued biting throughout the day until 5.30 p.m., reaching a maximum in abundance and annoyance about 3.30.

Colonisation of virgin country by the house-fly (*Musca domestica*).

Within the last few years the work of the Brazil-Venezuela-British Guiana Boundary Commission led to the rather frequent use, by surveyors and Indian porters, of two main routes to Roraima, which is the meeting place of the three frontiers. In 1932 the writer used both routes, going by the British one, which led most of the way through mountain forest, along the left bank of the Ireng River to its head, and then along the border above the sources of the Mazaruni, and returning by the Venezuelan supply-route, across the Venezuelan and Brazilian savannahs to the Uraricuera River. Both paths are now disused, save by infrequent wandering Indians. The forest route was never more than a series of Indian paths, passable only by carriers in single file, but the Venezuelan trail, on the other hand, passing chiefly through open savannahs, was negotiable on horse-back, and was traversed by parties of Indian porters, sometimes as numerous as 350. The British employed far fewer Indians at any one time. In both cases the trails led through practically virgin country, but the Venezuelan route was about half as long (approximately 112 : 230 miles) as the other. In all of the ranch houses, both British and Brazilian, on the Rupununi-Rio Branco savannahs where both tracks began, the house-fly was present, and in several it was exceedingly abundant, breeding in pit-privies and practically covering the table at meal times. I was greatly interested by the fact that, almost as soon as we left the savannahs, to take the Ireng (forested) route, and entered the foothills of the Pakaraimas, house-flies ceased, and in none of the small settlements of the Patamona, Akawai and Serekong Indians,* whether in the forest or in upland savannahs, did we see a trace of this insect until we reached the Venezuelan Commission camp at Mount Roraima. There it was comparatively abundant, and we found it also in the Taulipang Indian villages along the savannah route to the Uraricuera. From one settlement to another it sometimes accompanied us the best part of a day, settling now and then on the men's loads of dried meat and other food. It was occasionally with us too when we had no meat. Thus along this line it had colonised the whole route to Roraima,in spite of the fact that the prevailing strong savannah winds (N.E.) would be against it, whereas on the British side the forest, although offering shelter, had apparently proved an insuperable difficulty from the outset. How much the occasional horse and bullock traffic on the savannah route had helped it would be difficult to say.

Curiously enough this case was exactly paralleled by that avian house-fly, the black vulture (*Catharista atrata*). This species in contrast to the turkey buzzards (*Cathartes* spp.) and the King vulture (*Gypagus papa*), is very much a lover of settled and even urban districts. I never saw it, however, in the settlements of the forest Indians, and it disappeared from the British (forested) route to Roraima, ten miles before the house-fly, before in fact we actually entered the Pakaraima foot-hills. In contrast, on the savannah trail, it was present for at least half the distance from the Uraricuera to Roraima.

Observations on miscellaneous insects.

Facultative bloodsucking by phytophagous Hemiptera.—In 1929 I published collected records on this subject. Mr. Pickles, at Santarem, on the Amazon, added another when he gave me for identification a small green leafhopper of the Cicadellid genus, *Parabolocratus*, which bit his arm under the electric light. At Manáos a small Anthocorid bug, not yet named and of unknown normal feeding-habits, settled very quietly on my wrist, under electric light, leisurely dug in

* It was not uncommon in the Macusi settlement, on the small Kurasabai savannah, about ten miles within the foothills, by a largely savannah route. Thereafter we entered forest and saw it no more.

its rostral setae, and began to suck blood. There was a steady yet sharp sting, but no mark nor irritation next day.

Platypodids as human parasites.—In January at a small camp in heavy lowland rain-forest, at the foot of the Kanuku Range, one evening at dusk, before we lit the lamp, countless swarms of a tiny Platypodid beetle suddenly settled on our persons, where many penetrated beneath the clothes. I was kept awake during the night by their incessant tickling, nor was this the worst for when pressed by hand or tightness of clothes they caused, either by biting or secretion, a small swelling, which first burned and then itched nearly as long and badly as bête rouge (*Trombicula*).

Mosquitoes attracted by blue colour.—The town of New Amsterdam (B. Guiana) is noted for almost intolerable swarms of biting mosquitoes, (*Aedes taeniorhynchus*, testé L. D. Cleare) which breed in the mangrove flats of the Berbice river. On the 30th of January three of us were walking along the river front, accompanied by the usual cloud of mosquitoes. One of us wore a navy-blue raincoat, another a pale green dress, while I had a whitish cotton-crash suit. On the backs of the latter and of the green dress there were settled three mosquitoes each. In very striking contrast, the blue raincoat bore a continuous thick grey felt of mosquitoes.

Sarcophaga sp. *developing on a minimum diet.*—In the Orinoco Delta I had blown two fresh eggs of a finch (*Saltator* sp.), washed them well, and left them to drain during the night and packed them in the morning as they seemed dry. When I unpacked them from a tight tin container a month later I found that 17 well-developed flies (*Sarcophaga* sp.), about the size of the house-fly, had emerged, evidently from larvae deposited while the eggs were draining. The eggs were unspoiled, and the only food the maggots could have had was the inner membrane and trace of egg albumen after the washing.

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PREPARATION OF ORANGES FOR SHIPMENT.

A recent paper in *Industrial and Engineering Chemistry*, July, 1934, Vol. 26, No. 7, pp. 762-765, by J. R. Winston, of the Bureau of Plant Industry of the United States Department of Agriculture, describes the modern methods employed to retard decay in orange shipments, and to improve the appearance of the fruit intended for the market. These include (besides the familiar refrigeration) the use of antiseptic washes which destroy organisms causing decay, the application of processes which retard natural biochemical changes in the fruit, and the application of blanching and polishing treatments which improve its appearance.

The first step in the preparation of oranges for market is the determination of maturity. Because the earliest shipments command the highest prices, an incentive to collect immature and unripe sour fruit is ever present. Lack of restraint in this matter may eventually kill the market, so that nowadays, maturity standards have been enforced by the larger fruit-producing companies. The standards vary for different kinds of citrus, and in different growing areas, but they are usually based on measurements of the ratio between total soluble substances (mainly sugars) to acids in expressed representative juice. For Florida oranges, for example, the accepted standard ratio is 8 to 1, as determined by chemical tests.

The chief organisms causing decay in citrus fruits are two species of *Penicillium*, viz.: *P. italicum* and *P. digitatum*, known as the blue moulds. The latter is able to infect fruits only at places where the rind is injured, but the first may spread from points of contact in the pack. Careful handling and packing greatly reduce damage by these organisms. The use of antiseptic washes also aids materially in reducing their incidence. The particular wash which has given most satisfaction is an eight per cent. solution of borax applied soon after harvesting and before blanching. Others are boracic acid solutions and solutions of sodium carbonate. Whilst the two last-named destroy blue mould, borax destroys stem-end rots as well. After treatment, the fruits should be washed in soft water.

Blanching is usually effected by the controlled application of ethylene gas. The process has been thoroughly investigated, and the exact conditions of operation have been carefully worked out. They are sufficiently well-known to the trade not to require re-stating.

Polishing is the final process applied to oranges and other citrus fruits before packing. The fruits are passed across horse-hair brushes, and frequently some substance is added to increase the surface shine. Thus, rosin, added to the washing solution, serves this purpose, but a mixture of paraffin wax with a mineral oil applied in a special machine furnishes a successful alternative. An emulsion of carnauba wax, used as a dip, is effective where brushing cannot be applied to delicate fruits, such as tangerines. The most widely-used polishing method, however, consists in brushing on to the fruits a small quantity of solid paraffin wax, introduced by pressing a bar of the material against the revolving brushes.

A NEW DRAINING MACHINE.

By Dr. H. Janert.
(*Leipzig University, Germany.*)

The new machine, which is described below makes and lays in one operation continuous concrete pipes in the subsoil, and requires no excavation.—Ed.

Introductory.

Although porous concrete pipes have already been successfully used for under drainage and subsoil irrigation, the full advantages have not hitherto been obtained on account of the high expenses of construction. The new machine which is described below cheapens the construction of such pipes by about 90 per cent., and thus opens up new prospects for subsoil irrigation and drainage.

The method might be of particular value in arid areas, where surface irrigation has led to an accumulation of salts and a deterioration of the soil. In such soils a system of closely arranged porous pipes, one to two feet deep and about two yards apart, could be used to drain off the salts washed down by heavy surface flooding.

The same pipe system can be used for subsoil irrigation. For this purpose, the pipe system should be constructed in such a way that a considerable area can be supplied with water from one point where the pipe system reaches the soil surface. The whole system should be kept full of water as long as necessary to allow the soil to take up enough water from the pipes by capillary suction.

Subsoil irrigation has the following great advantages over the ordinary surface irrigation :—

(1) Evaporation losses at the soil surface are almost entirely avoided, which means a thrifty water consumption.

(2) The accumulation of salts in the soil is greatly retarded, and the pipe system might at any time be used for drainage to remove the salts.

(3) The soil surface remains dry and of a favourable structure during the irrigation.

(4) Neither weeds nor plant parasites develop because the soil surface is kept dry.

The New Machine.

The machine consists of a mole plough carrying a special equipment which forms an endless porous concrete pipe in the tunnel left by the mole. The pipe is made while the mole is actually passing through the soil.

This procedure has been tried long ago, but with little success. The wet concrete mixture previously used either choked up the supplying tube, or did not hold the pipe profile, according to the moisture content of the material. The essential innovation of the new machine lies in the forming of the pipe, which is done with *dry* material, and the dry pipe is then wetted from the inside. By this method a faultless, uniform pipe is obtained, without smearing of its surfaces, so that the walls of the concrete pipe remain permeable. The permeability can be largely regulated by altering the proportion of the cement-sand mixture.

Fig. 1. shows the machine, the main parts of which are a pair of sledges (*a*) carrying a coulter (*b*) and a strong share (*c*) with the mole (*d*) at its lower end. The steering is done by pulling the drawbar (*e*) to one side or the other. A hopper (*f*) contains the dry cement-sand mixture which is forced by means of a positive feed down a pipe (*g*) behind the share to a plug (*h*) which forces it out into an annular shape, thus forming a hollow pipe in the tunnel made by the mole. At the same time the inside of the pipe is moistened with a small supply of water delivered by the hollow plug through a porous ring of artificial pumice, which is connected to a small reservoir of water (*i*) by a tube running down inside the share. Sufficient rigidity is thus given to the pipe to hold it in position while it is absorbing sufficient moisture to set hard.

Fig. 2 shows the machine (but an early experimental model) at work on the field. Here it is drawn by a simple winch, but for extensive piping a tractor will generally be used.

Fig. 3 shows a pipe made by the new machine lying in its original position. From one end the so, has been removed to show the correct construction.

It is evident that this method of piping the subsoil is extremely simple (being only slightly more expensive than ordinary mole draining) and compares favourably with other methods which need numerous separate processes, including pipe making, transport, trenching, pipe laying, joint-tightening and refilling of the trenches. The machine is inexpensive, not only in operation, but also in its initial cost, the latter being only £30 at normal exchange rates.

BROWNING OF ORANGE JUICES.

It is well known that orange juice, when exposed to air, gradually turns colour from yellow to brown, and at the same time loses its ability to reduce iodine and other oxidising agents employed to test citrus juices. Investigations have been conducted by Messrs. M. A. Joslyn, G. L. Marsh and A. F. Morgan (*Journ. Biol. Chem.*, 1934, p. 17) to determine whether the browning of orange juices involves any change in their content of vitamin C (the anti-scorbutic vitamin). Two batches of Navel Orange juice and one of Valencia Orange juice were tested. The results obtained show that a decrease in the iodine-reducing value accompanies a decrease in loss of vitamin C, and occurs at about the same rate. This suggests that oxidation, resulting in browning, simultaneously destroys the vitamin C factor in these juices. Navel Orange juice contains a greater concentration of reducing substances than Valencia juice.

On freezing for storage purposes, the loss of reducing value of orange juices was more marked in samples that had previously become partly oxidised. Evidently exposure to oxidation by air may greatly diminish the anti-scorbutic potency of citrus juices, and should be avoided as much as possible during manufacture, storage, bottling or canning.

A NEW DRAINING MACHINE.

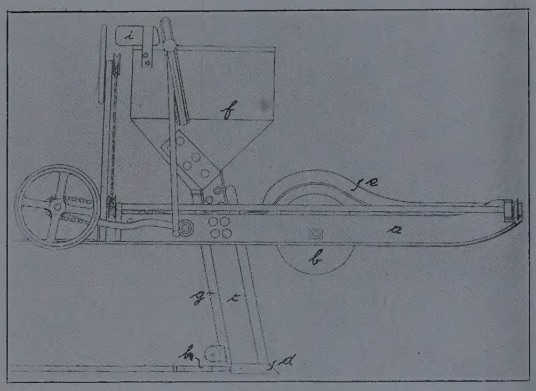

FIG. 1.—*Diagramatic Section of the New Machine. (d) Mole. (f) Cement Hopper. (i) Water Reservoir. (h) Forming Plug.*

FIG. 2.—*Experimental Model in Use. Winch-tractor; Motor tractor used in field work.*

FIG. 3.—*Laid Concrete Pipe made by the new machine.*

DECOMPOSITION OF PINEAPPLE TRASH BY BACTERIA AND FUNGI.

PLATE 1.—*Freshly shredded Pineapple trash about* 100 *Tons Green Material per acre.*

PLATE 2.—*Freshly Shredded Pineapple Stumps.*

DECOMPOSITION OF PINEAPPLE TRASH BY BACTERIA AND FUNGI.*

BY

O. N. ALLEN, F. A. E. ABEL AND O. C. MAGISTAD.†

Introduction.

VARIOUS papers by Waksman *et al* have appeared in the last decade emphasizing decomposition processes of plant organic matter and their influences upon the soil. The extent to which plant material influences soil microflora which in turn determines plant decomposition has been shown to be dependent upon the chemical nature and physical condition of the plant material (21, 22, 26).

Little information is available concerning the decomposition of the pineapple plant *Ananas comosus* (L.) Merr. in soil and the influence of the processes upon soil microflora. Vosbury and Winston (24) have remarked that in Florida old pineapple plants are usually grubbed out and burned since disease outbreaks usually occurred when the new plantings were made in the soil where decomposition of the trash had taken place.

In Hawaii the burning of pineapple plant residua was customary until recent years. Now the trash is usually shredded or cut by discs and after some decomposition, it is ploughed under. The condition of freshly shredded material is shown in Plate 1 and of individual pineapple stumps in Plate 2.

In many areas throughout the territory the decomposition of trash is fairly rapid while in the drier regions the process is greatly retarded. However, various factors are considered other than the absence of sufficient moisture. The local belief that some Hawaiian soils are at a low biological level has led to the assumption that in some areas decomposition of plant material is greatly retarded because of the absence of the necessary bacteria and fungi. The desire to learn something of the decomposition of pineapple trash under optimum conditions, similar to those of the field, has prompted the following study.

Methods of Analysis.

Moisture, ammonia nitrogen, nitrate nitrogen, and microbial counts of micro-organisms in the soil containing the pineapple material were determined at seven-day intervals. Moisture was determined by drying a weighed quantity of the soil at 100-105 degrees C. to a constant weight. The per cent. of moisture was then calculated on the dry soil basis. Ammonia nitrogen and nitrate nitrogen were determined according to Harper (5, 6).

Pineapple trash consisting of entire stumps, chopped leaves, and chopped stumps was analysed for moisture (17 *a*), sugar (17 *b*), starch (17 *c*), total nitrogen (17 *d*), hemicelluloses (1), lignins (18) and cellulose (2, 3). Determinations of fats, waxes, oils and resins were made on the whole stump material in addition to the above mentioned substances. These latter substances were determined by extraction with ether. Protein was obtained by multiplying the total nitrogen by the factor 6.25.

Each sample of soil used in estimating numbers of organisms was obtained from the upper two-inch layer. Three boring cores were composited for each individual sample. The numbers of bacteria, fungi, and actinomyces in the soil were determined according to the method prescribed by Waksman and Fred (25). The micro-organisms were counted after five days' incubation at room temperature (25° C).

Two lateritic soils from neighbouring fields were used in these experiments. They contained about 30 per cent. SiO_2 and 40-50 per cent. iron and aluminium oxides and were derived from lavas. Most pineapple soils are acid and the particular soils used in these studies had a value of about pH 5.0.

Experiment 1.—Decomposition of Pineapple Stumps.

Experiment 1 covering a period of 104 days consisted of a set-up of three galvanized iron cans each of which contained approximately 7,000 grams of soil. One whole pineapple stump approximately 110 grams in weight was placed horizontally to the soil in Can 2 and another in Can 3 so that about one-half of each stump was covered with soil. The stumps used in the analysis of the material prior to decomposition as well as those subjected to the decomposition process were selected at random from a composite sample of stumps. The analysis of this composite sample is also used as the analysis of the original stumps in Experiment 2 except that the ether extract has been omitted.

During the experiment the soil was kept at a moisture content of approximately 25 per cent. and at a temperature of 25 degrees C. Can 1 contained soil without a stump and was therefore considered as a control. In Cans 2 and 3 containing entire stumps efforts were not made to count the numbers of micro-organisms on or in the plant material. Dependable sampling of the plant material to accomplish this aim would have been accomplished not only with great difficulty but with little accuracy. Periodic sampling of the stump material over a period of 15 weeks would have resulted in (*a*) disrupting the decomposing material, (*b*) opening new areas of the stump to infection, (*c*) the obtaining of erroneous results due to the presence of various localized

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areas of decomposition, and (*d*) very little of the plant material would have been left for final chemical analysis. However, very small portions of the decomposing stumps were collected at various times with a loop wire needle in an attempt to isolate the organisms actually present in the decomposing areas. It was hoped that by such a procedure the most important organisms in the decomposition process could be isolated.

The chemical analysis of the stump material before and after decomposition appears in Table 1. The constituents have been expressed in per cent. of original sample. The greatest difference between decomposed and original material was accounted for by loss of sugars, starches, and cellulose. In Can 2, 55.23 per cent. of the stump was decomposed after the 104 days while a 62.20 per cent. loss was noted in the stump of Can 3. Slight increases in lignin and, in one case, in protein were noted; however, the individual stumps used in Cans 2 and 3 very likely had analyses varying slightly from the mean of the same lot of stumps analysed prior to decomposition. It is therefore impossible to state that small differences, as in the case of lignin, actually arose as a result of decomposition.

Table 1.—Chemical Analysis of Pineapple Stumps before and after a Decomposition Period of 104 days in Soil.

	Analysis of Pineapple Stumps prior to Decomposition.	Analysis of Pineapple Stumps after Decomposition.	
		Can 2	Can 3
Original wet weight ..		420.0 gms.	363.0 gms.
Original dry weight ..		116.6 „	100.8 „
Final dry weight		52.2 „	38.1 „
Per cent. decomposed (dry) ..		55.23	62.20
	Per cent. based upon original dry weight		
Sugars ..	2.65	none	0.04
Starch ..	45.70	0.14	0.16
Hemicellulose ..	4.48	7.77	6.13
Cellulose ..	34.05	18.97	16.87
Lignin ..	7.78	9.98	8.28
Ether extract (fats, waxes, &c.) ..	3.28	2.36	2.03
Protein ..	6.08	6.79	5.74
Undecomposed by analysis ..	—	44.01	39.25
Undecomposed by weight ..	—	44.77	37.80

There was a marked stimulation in population of bacteria, fungi, and actinomyces in the soil containing stump material as seen in Table 2.

Figure 1 shows the numbers of micro-organisms in Cans 1 and 3 expressed in logarithms. The numbers of organisms at the various sampling dates in Can 2 were almost identical with those in Can 3 and have therefore been omitted in Figure 1. The greatest increase in the population of each can was in the numbers of fungi, followed by the bacteria and actinomyces. Fungal growth became very apparent on the surface of the soil and on the stumps in Cans 2 and 3 after one week of incubation. Species of Penicillium, Aspergillus, Fusarium, Alternaria and Trichoderma were exceedingly common in the matty fungal growth covering the stump material. However, the dense fungal mycelium was not conspicuous after the third week. The portion of the stump under the surface of the soil showed a state of decomposition approximately equal to that immediately under the surface of the fungal mat. Isolations of the stump material showed bacteria, fungi, and actinomyces to be extremely abundant and somewhat uniform in distribution over the stump material.

Laboratory tests of a qualitative nature showed evidences of active nitrification and nitrogen fixation in the soil samples during the incubation period. The transformation of ammonium nitrogen to nitrate nitrogen in solution studies (4, medium 48) was most pronounced from the third to the eighth week. Cultural studies also showed a marked abundance of Azotobacter and Clostridium species.

Experiment 2.—Decomposition of Chopped Stumps and Leaves.

The purpose of this experiment was to ascertain the degree of decomposition of the entire pineapple plant and its effect upon the soil when incorporated according to field practice. The laboratory plan consisted of five galvanized iron cans each of which could be sealed appropriately for the collection of gases. Nine kilograms of soil were placed within each can. The duration of the experiment was 81 days.

The following plant material was thoroughly incorporated with the soil in the cans:

Can No. 4—Control can, no plant material was added.

Can No. 5—700 gms. of fresh, coarsely cut pineapple stumps, approximately one inch cubes.

Can No. 6—700 gms. of fresh, finely cut pineapple leaves.

Can No. 7—700 gms. of fresh, coarsely cut pineapple leaves.

Can No. 8—700 gms. of fresh, finely cut pineapple stumps.

Table 2.—Numbers of Colonies of Bacteria, Fungi, and Actinomyces in Soils containing Entire Stumps. (Numbers of Colonies expressed in thousands per gram.)

Incubation Period Weeks.	Control can. No Stump Added. Can 1.			Soil containing pineapple stumps.					
				Can 2.			Can 3.		
	Bacteria.	Fungi.	Actino-myces.	Bacteria.	Fungi.	Actino-myces.	Bacteria.	Fungi.	Actino-myces.
0	96.0	5.0	60.0						
1	108.0	98.0	60.0	513.0	335.0	372.0	576.0	219.0	329.0
2	171.0	211.0	88.0	360.0	422.0	420.0	615.0	380.0	647.0
3	210.0	356.0	102.0	3,980.0	29,460.0	730.0	758.0	6,620.0	834.0
4	254.0	476.0	143.0	7,820.0	38,700.0	1,100.0	15,760.0	17,440.0	17,920.0
5	164.0	197.0	87.0	2,430.0	14,500.0	980.0	10,980.0	13,560.0	12,380.0
6	146.0	145.0	62.0	1,852.0	12,800.0	772.0	8,960.0	9,800.0	10,240.0
7	152.0	157.0	68.0	2,580.0	11,300.0	700.0	4,560.0	9,200.0	1,926.0
8	142.0	156.0	59.0	2,190.0	9,400.0	596.0	3,940.0	10,420.0	2,076.0
9	129.0	128.0	56.0	1,170.0	8,330.0	574.0	1,954.0	9,660.0	1,028.0
10	147.0	129.0	65.0	1,000.0	3,580.0	542.0	1,194.0	5,380.0	788.0
11	138.0	124.0	61.0	978.0	2,770.0	636.0	1,004.0	3,748.0	728.0
12	132.0	121.0	61.0	1,060.0	3,090.0	688.0	1,042.0	2,880.0	608.0
13	148.0	123.0	87.0	1,020.0	2,340.0	792.0	924.0	3,230.0	554.0
14	130.0	194.0	87.0	972.0	1,670.0	812.0	848.0	2,400.0	668.0
15	133.0	116.0	71.0	914.0	1,910.0	772.0	814.0	1,190.0	750.0

The 700 grams of fresh pineapple material when calculated to the acre foot (2,400,000 pounds) approximated 93 tons per acre of trash on the wet basis. This amount compared favourably with the estimate of pineapple trash normally obtained and subjected to decomposition at the end of the crop cycle under field conditions.

The results of the chemical analysis of the plant material before and after decomposition are cited in Table 3.

At the time of the final analysis the general appearance of the leaf material of Can 7 was only slightly changed with the exception of a loss of green colour and a drying of the tissue. The stump material of Can 5 retained its original form during the period of decomposition but had softened considerably, and when torn apart appeared to consist of a white powder plus hair-like fibres. The plant residue in Cans 6 and 8 was negligible after the 81 day period, thus satisfactory samples for analysis were not available.

Only a trace of the sugars remained in the stump and leaf materials at the conclusion of the experiment. It is interesting to note that there was practically no loss of starch from the leaf material while the stump material showed a loss of 82 grams during the 81 day period. Slight losses of approximately 2 grams of hemicellulose in each of Cans 5 and 7 were noted. This result was more or less surprising since a large percentage of the mixed microflora of soil is able to utilize hemicelluloses. Waksman and Diehm (28) found that almost all of the micro-organisms in their experiments were able to attack specific hemicelluloses and that the Phycomycetes were as active in the process as the cellulose decomposing bacteria. Actinomyces were also found by the above authors (27) to be especially active in the decomposition of hemicelluloses under favourable cultural conditions. A loss of 15.94 grams of cellulose was noted in the stump material while a gain of 3.33 grams was obtained in the leaf analysis.

The losses by decomposition in the coarsely cut leaf material were very slight, being only 6.83 per cent. by weight. This entire loss could easily be accounted for by the decomposition of the sugar fraction. A loss of 53.66 per cent. was obtained in the case of the coarsely cut stumps during the decomposition period.

Slight increases in lignin and protein were also noted in both analyses of the decomposed fractions. This general result has been shown to be true in the decomposition studies of other plant materials. Tenny and Waksman (21) noted lignin values of 18.26 per cent. after 27 days, 19.66 per cent. after 68 days, 23.44 per cent. after 205 days, and 23.86 per cent. after 405 days in decomposing cornstalks under aerobic conditions compared with a value of 11.28 per cent. lignin in the original sample. As high a value as 12.97 per cent. crude protein was obtained after 405 days in comparison with the original content of 1.98 per cent. The same situation has been shown to be true in the decomposition of rye straw (21), oak leaves (21) and alfalfa (21). Studies under anaerobic conditions showed similar results (22).

Table 3.—Chemical Analyses of Pineapple Stump and Leaf Material before and after Decomposition Period of 81 days in Soil.

	Analysis of Material prior to Decomposition.		Analysis of Material after Decomposition.	
	Stumps.	Leaves.	Coarsely cut Stumps	Coarsely cut Leaves.
			Can 5.	Can 7.
Original wet weight ..	700.00 gm	700.00 gm		
Original dry weight	194.25 ,,	144.90 ,,		
Final dry weight ..	—	—	90.00 gm	135.00 gm
Per cent. decomposed (dry) ..	—	—	53.66	6.83
	Per cent. based on the original dry weight.			
Sugars ..	2.65%	8.41%	trace	trace
Starch ..	45.70	1.56	3.60%	1.83%
Hemi-cellulose ..	4.48	17.60	3.59	15.87
Cellulose ..	34.05	35.75	18.90	39.08
Lignin ..	7.78	18.92	9.00	19.74
Protein ..	6.08	5.68	3.87	5.59
Undecomposed by analysis ..	—	—	38.97	93.39
Undecomposed by weight ..	—	—	46.34	93.17

Considerable variation in nitrate values occurred in the variously treated soils as noted in Table 4.

Cans 6 and 8 containing finely chopped pineapple leaves and stumps respectively showed immediate drops from 25.4 p.p.m. to 1.8 and 4.7 p.p.m. respectively within the first incubation period of four days. Thereafter the nitrate values of the two soils were practically negligible throughout the period of 81 days. It is very likely that in the presence of the readily available carbohydrates present in the plant materials of Cans 6 and 8 the micro-organisms assimilated the inorganic nitrogen and rapidly converted it into microbial protoplasm. This situation was not true in Cans 5 and 7 where the carbohydrates were less readily available. Figure 2 shows the average ammonia and nitrogen values for the field soil and each of the soils of Cans 4 to 8 during the study.

Carbon dioxide was determined by collecting the gases produced in each can in a 2 N solution of sodium hydroxide by first precipitating it as barium carbonate with barium chloride and titrating the excess sodium hydroxide with 1 N acid. The cans were aerated by passing air over the soil at the rate of about two miles per hour, which is comparable to average field conditions. To maintain the soil at a desired moisture content the incoming air was passed through sulphuric acid solution having a relative vapour pressure of 75 per cent. The cumulative weights of carbon dioxide from the various pineapple materials have been expressed in Figure 3.

Decomposition processes began immediately, if the progressive yield of carbon dioxide evolution may be considered a good index. The physical condition of the plant material in Cans 6 and 8 was very likely responsible for the rapid increase

Table 4.—Determinations of Moisture, Nitrates and Ammonia in Soil Containing Decomposing Pineapple Materials. (Determinations on dry soil basis.)

Incubation of Decomposing Material.	Can 4. No Plant Material. Control.			Can 5. Soil plus Coarsely cut Stumps.			Can 6. Soil plus finely chopped Leaves.			Can 7. Soil plus leaves cut in inch Squares.			Can 8. Soil plus finely chopped Stumps.		
Days.	Moisture %	N (NH_3) p.p.m.	N (NO_3) p.p.m.	Moisture. %	N (NH_3) p.p.m.	N (NO_3) p.p.m.	Moisture %	N (NH_3) p.p.m.	N (NO_3) p.p.m.	Moisture %	N (NH_3) p.p.m.	N (NO_3) p.p.m.	Moisture %	N (NO_3) p.p.m.	N (NH_3) p.p.m.
0	26.88	30.7	25.4												
4	26.66	38.2	15.8	27.57	38.5	13.4	29.02	44.4	1.8	26.30	43.3	15.8	29.42	38.8	4.7
11	25.37	41.3	14.8	28.20	30.7	8.2	31.78	31.7	0.9	26.96	30.5	17.0	27.91	30.7	3.8
18	18.38	28.3	14.8	26.80	30.5	5.6	29.71	31.0	0.8	26.67	30.5	17.5	27.29	30.5	2.5
25	24.33	40.9	17.8	27.60	38.4	8.4	29.84	42.9	1.2	28.10	42.2	23.3	28.33	42.2	0.6
32	36.36	35.9	18.1	27.00	40.9	10.0	26.49	41.6	1.0	26.30	52.9	21.5	27.61	42.2	1.1
39	28.80	38.7	16.0	26.66	34.3	13.3	27.33	38.1	1.7	25.86	37.8	31.4	26.84	38.1	1.7
46	25.91	34.0	18.1	27.75	34.6	32.0	27.47	38.1	1.0	26.33	37.8	25.3	27.11	38.1	1.1
53	21.43	29.0	17.5	25.06	33.8	31.5	25.87	37.8	1.0	24.21	37.2	24.9	25.59	34.0	1.1
60	20.93	15.5	13.6	22.93	14.8	21.6	24.50	22.5	1.3	21.69	25.6	22.0	32.50	19.8	1.4
67	19.38	17.9	13.3	24.40	14.9	13.4	24.12	11.2	1.5	21.60	18.3	24.4	24.36	14.6	1.3
74	31.20	19.7	26.3	27.95	23.0	14.8	32.95	23.8	2.7	33.78	20.1	22.7	32.99	20.0	1.9
81	26.90	26.7	22.3	24.90	26.3	12.5	28.64	27.1	2.6	26.90	38.1	22.3	30.47	27.3	1.0
Means	25.58	30.50	17.98	26.40	30.06	15.39	28.14	32.56	1.46	26.23	34.53	22.34	28.37	31.36	1.85
S.E.	1.071	2.529	1.192	0.508	2.642	2.614	0.822	3.006	0.019	0.947	3.024	1.285	0.783	2.812	0.375

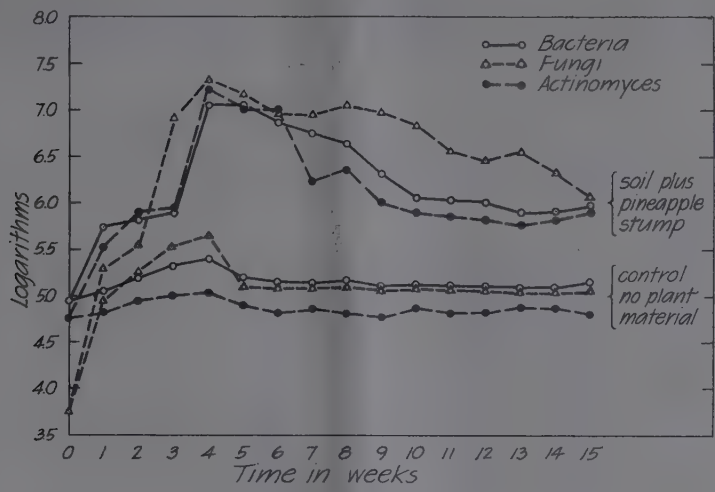

Figure 1. Numbers of Bacteria, Fungi and Actinomyces in Soil with and without Pineapple Stumps.

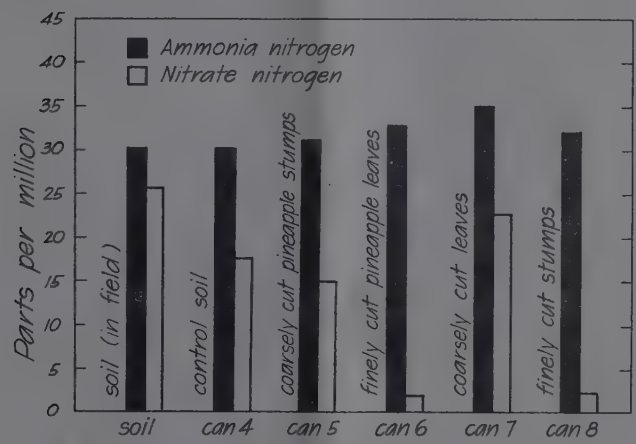

Figure 2. The Mean Contents of Ammonia and Nitrate Nitrogen in Control Soil and Soil containing Decomposing Pineapple Stumps and Leaves.

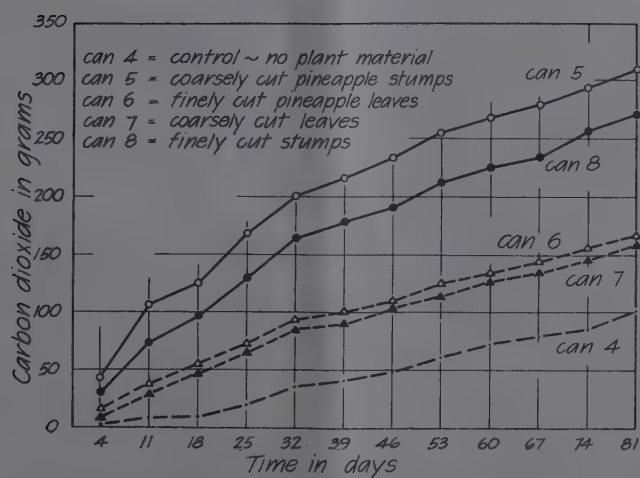

Figure 3. Cumulative Amounts of Carbon Dioxide evolved during the Decomposition Period from Soil alone and Soil containing Decomposing Pineapple Stumps and Leaves.

Table 5.—Numbers of Colonies of Bacteria and Fungi in Soils Containing Decomposing Pineapple Stump and Leaf Materials. (Numbers of Colonies expressed in thousands per gram.)

Days.	Can 4 No Plant Material.		Can 5 Coarsely cut Stumps.		Can 6 Finely chopped Leaves.		Can 7 Coarsely cut Leaves.		Can 8 Finely chopped Stumps.	
	Bacteria.	Fungi.	Bacteria.	Fungi.	Bacteria.	Fungi.	Bacteria.	Fungi.	Bacteria.	Fungi.
0	1,650.0	1,970.0								
4	2,750.0	2,250.0	59,800.0	44,900.0	23,000.0	17,800.0	2,720.0	2,620.0	69,600.0	53,300.0
11	1,600.0	1,300.0	15,500.0	13,800.0	24,300.0	19,900.0	16,000.0	2,100.0	71,000.0	60,000.0
18	600.0	800.0	7,200.0	1,100.0	13,600.0	1,700.0	8,900.0	1,400.0	18,000.0	2,200.0
25	700.0	150.0	650.0	530.0	2,390.0	3,400.0	990.0	1,550.0	4,600.0	1,600.0
32	490.0	360.0	3,010.0	2,730.0	7,200.0	3,700.0	3,600.0	3,100.0	5,600.0	3,900.0
39	280.0	—	1,600.0	—	3,000.0	180.0	1,000.0	—	2,600.0	700.0
46	340.0	130.0	10,300.0	1,470.0	9,750.0	270.0	6,850.0	1,490.0	7,960.0	1,000.0
53	1,120.0	320.0	7,400.0	3,600.0	9,000.0	1,160.0	4,510.0	1,300.0	2,370.0	2,450.0
60	810.0	560.0	5,350.0	1,250.0	10,040.0	5,300.0	5,300.0	1,170.0	3,450.0	1,050.0
67	550.0	50.0	7,500.0	500.0	4,400.0	130.0	1,250.0	100.0	3,800.0	130.0
74	380.0	350.0	4,050.0	3,100.0	7,000.0	3,750.0	4,700.0	1,500.0	5,600.0	3,400.0
81	910.0	720.0	8,650.0	3,950.0	3,900.0	2,200.0	6,850.0	130.0	1,900.0	1,500.0

and gradual incline of the CO_2 volume. Very little difference was noted in CO_2 evolution of Cans 5 and 7 consisting of coarsely cut stumps and eaves respectively.

The variations in microbial counts have been expressed in Table 5. A marked rise in numbers of organisms was noted in all the soils of Cans 4 to 8 during the first two weeks of incubation after which the abundance of organisms apparently decreased. The species of fungi named in Experiment 1 were likewise abundant. The numbers of organisms in the soil of Can 4 which did not contain plant material remained fairly stable.

Discussion.

Waksman (29) has noted three possible methods of determining the index of decomposition of organic matter, (*a*) by measuring the disappearance of only one or more of the plant constituents, such as cellulose or pentosan, (*b*) by the accumulation of one of the final products of the reaction, such as carbon dioxide, ammonia or nitrate, and (*c*) by measuring the soil humus content. In some cases an understanding of the numbers and kinds of micro-organisms has been very helpful. An attempt has been made to employ several of these methods within the scope of this study.

Considerable emphasis in the past has been placed upon the value of CO_2 evolution in measuring decomposition processes of carbohydrate material. Lemmerman *et al* (11), Stoklosa and Ernest (20), van Suchtelen (23), Starkey (19) and others have shown CO_2 evolution to be a valuable index. However, its value is limited by the fact that CO_2 is not the only product formed from the carbon of the organic matter and that much of the gas is reassimilated by micro-organisms.

A somewhat close correlation between carbon dioxide evolution and chemical analysis was obtained in the case of Can 5 containing coarsely cut pineapple stumps and Can 7 containing coarsely cut leaves. The greatest evolution of carbon dioxide obtained in Can 5 was accompanied by a loss of 53.66 per cent. of the dry plant material while the lowest amount of CO_2 evolved, in the case of Can 7, accompanied only a loss of 6.83 per cent. dry matter. Data on the chemical analysis of the finely cut material was not available due to the impossibility of recovering the plant residue from the soil. The starches, sugars and celluloses were subject to the greatest degree of reduction. A loss of 5 grams of sugars, 82 grams of starch and 29 grams of cellulose corresponded well with the amount of CO_2 released. In the case of the coarsely cut leaves, the loss was accounted for by the disappearance of sugars. However, this loss of 12 grams is less than indicated by the carbon dioxide evolution but agrees well with recorded loss in dry weight.

Hutchinson and Milligan (10), Martin (14), Maynard (16), Wright (30), Holtz and Singleton (9), Waksman (29), and others have shown the accumulation of nitrates in soil to be a good measure of decay and that the greater the accumulation of nitrates, the greater the rate of decay. In this study less value may be placed upon the determinations of ammonia and nitrate nitrogen as good indices of decomposition since in the presence of excess carbohydrates or such compounds serving as sources of energy for micro-organisms the ammonia and nitrate are rapidly changed to proteins. Recently Martin (14, 15) has shown the accumulation of nitrates to accompany humus formation. In the light of this work less humus would be expected in soils containing finely chopped pineapple leaves and stumps since nitrate accumulation was practically negligible.

The disappearance of nitrate nitrogen in the soils of Can 6 and Can 8 (experiment 2) together with no evidence of nitrification in subsequent cultural studies was very likely due to the influence

of the chemical composition of the plant material upon the biological activities. Data in Table 3 have shown 94.62 per cent. of the stump and 81.74 per cent. of the leaf to be starches, celluloses, hemicellulose and lignin. The influence of these constituents on the destruction of nitrates has been shown by various workers. Lipman *et al* (12) have shown that the addition of soluble carbohydrates decreased the accumulation of ammonia and in later work (13) of nitrates, also the production of CO_2 was increased. The injurious effect of cellulose was shown by Hill (7, 8) to persist for 32 weeks after which nitrification progressed slowly. It seems logical to assume that in the case of pineapple leaves as well as of the finely chopped stumps that such substances as starch, cellulose, lignin and hemicellulose furnished a suitable medium for many micro-organisms that converted nitrate into microbial protoplasm. In such a case the nitrogen would be temporarily tied up and then later released by processes which might stimulate nitrification. This situation was not so evident in the soils of Cans 5 and 7 where the carbohydrates were less readily available due to the physical condition of the material.

The estimation of numbers of micro-organisms present in the surrounding soil has not been of great value as an index of decomposition in this study. Significant differences in numbers of fungi, bacteria, and actinomyces were noted in Figure 1 of Experiment 1. Also in Experiment 2 each type of plant material stimulated an increased population of micro-organisms in comparison with the control. However, correlation of numbers of micro-organisms with kinds of plant material in Experiment 2 was not possible beyond the first 11 days' incubation. Significant differences in numbers of micro-organisms in soils of Cans 5, 6, 7 and 8 in comparison with the control can were evident.

It was worth while to note that the soils used showed moderate populations of bacteria, fungi and actinomyces, and that the numbers of these micro-organisms ncreased following the addition of the plant material. The fungi were especially active in the decomposition process as manifested by their surface mycelium growth as well as by noting their penetration into the coarse material.

Summary.

In the present study two experiments have been described in which the decomposition of entire pineapple stumps, coarsely cut and finely cut stumps, and coarsely cut and finely cut leaves in soil was analyzed by chemical and microbiological methods.

Chemical analyses of the plant material, carbon dioxide, ammonia and nitrate nitrogen determinations have been employed in estimating the rate and extent of decomposition of pineapple stumps and leaves. The determinations of the numbers of bacteria, fungi, and actinomyces were made on the soil in order to ascertain the effect of the plant material and its decomposition upon the microbial population.

The results were not sufficiently conclusive to warrant recommending any one index of decomposition. Correlation between carbon dioxide evolution and chemical analysis of plant material was acceptable. The greatest loss in the decomposition of the stumps was in sugars, starches and cellulose, while in the case of the leaves the greatest loss was in sugars. Losses in whole stumps were 55.23 per cent. and 62.20 per cent. after a decomposition period of 104 days. Losses of 53.66 per cent. and 6.83 per cent. were obtained in coarsely cut stumps and coarsely cut leaves respectively after 81 days' incubation. Largest amounts of carbon dioxide resulted from the soil containing coarsely cut stumps, followed by those from soils containing finely chopped stumps, coarsely cut leaves and finely chopped leaves.

There were no appreciable differences in the amounts of ammonia nitrogen in the soils containing the various constituents of the trash. Marked differences, however, were obtained in nitrate nitrogen values of the various soils. The greatest average amount of nitrate nitrogen occurred in the soil containing coarsely cut pineapple leaves. Lesser amounts of nitrate nitrogen occurred in soils containing coarse and finely chopped stumps and finely chopped leaves than in the control. Almost negligible amounts of nitrate nitrogen resulted in soils containing finely chopped leaves and finely chopped stumps.

The addition of trash stimulated the growth of bacteria, fungi and actinomyces. Generally, however, pineapple leaves had a lesser stimulating effect upon the numbers of micro-organisms than did the stumps, an effect due undoubtedly to their chemical composition as well as their physical nature. A study of types of micro-organisms showed that the soils used were populated by those micro-organisms capable of carrying on decomposition processes of pineapple materials.

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"MARBLE" ARROWROOT.

In the journal *Food* for March, 1934, Dr. P. H. Jones describes the appearance and properties of arrowroot starch grains. During the war, extensive adulteration of arrowroot with sweet potato starch was undoubtedly practised, but such adulteration was generally abandoned afterwards. In recent years, however, analysts have reported cases of what appeared to be adulteration by sweet potato starch, although the source could not definitely be traced. Extended search has now revealed the source as a bulb-shaped tuber known as "marble" arrowroot, that grows naturally in the fields of some arrowroot estates in St. Vincent. Planters who were aware of the presence of "marble" arrowroot in their crops, failed to recognise it as anything but ordinary arrowroot, and allowed it to be pulped along with the true arrowroot rhizomes.

The starch of "marble" arrowroot resembles that of sweet potato very closely. The grains are smaller than those of true arrowroot, and are truncated at the ends instead of rounded. The plant which produces "marble" arrowroot has been identified at Kew as *Myrosma cannifolia* (synonymous with *Calathea myrosoma*), belonging to the same family (Marantaceae) as the true arrowroot which is *Maranta arundinacea*. The plant is indigenous to St. Vincent, Guiana and Brazil. Steps are being taken to eradicate it from the arrowroot fields of St. Vincent, so that, in future, importations of St. Vincent arrowroot shall not be rendered liable to condemnation under the Food and Drugs Act.

BALANSIA TRINITENSIS.

FIG. 1.—*Infected inflorescence (left).*
Healthy inflorescence (right).

FIG. 2.—*Healthy inflorescences (left).* *Infected inflorescences (right).*

THREADBLIGHT OF THE TONCA BEAN.

FIG. 2.—*Detail of disease. (A) On leaves. (B) On twig.*

FIG. 1.—*A diseased branch.*

BALANSIA TRINITENSIS (COOKE AND MASSEE). AN INTERESTING TRINIDAD FUNGUS.

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Balansia trinitensis was described in 1889 by Cooke and Massee (1) from an infected inflorescence of *Panicum palmifolium* Willd. sent to Kew from Trinidad. It is mentioned in the Preliminary List of Trinidad Fungi published by J. B. Rorer (2) in 1911 as commonly occurring on *Panicum palmifolium*, and again in the Further Preliminary List of Trinidad Fungi by C. A. Thorold (3) published in 1931. During the months of June, July, August and September, 1934, it was abundant on both *Chaetochloa palmifolia* (Willd.) (syn. *Panicum palmifolium*, Willd.) and *Chaetochloa sulcata*, (Aubl.) (syn. *Panicum sulcatum*, Aubl.). These two grasses closely resemble each other, but the former is larger, has a lax drooping panicle, and hispid leaf-sheaths; while the latter is smaller, has a stiff upright panicle and practically glabrous leaf-sheaths. Both are commonly called Gamalote or Gamelot grass and are found on cacao estates where they are troublesome weeds; *Chaetochloa sulcata* is in addition a common roadside weed. *Balansia trinitensis* is very common on both species and does not seem to have been previously recorded on *Chaetochloa sulcata*.

The perfect stage of the fungus as well as the pycnidial or *Ephelis trinitensis* stage was collected from many localities in the Northern Range, the centre of the island, and in the extreme South.

Balansia is an Ascomycete genus most nearly related to the genera *Claviceps* and *Epichloe*, of the family *Hypocreaceae*, but differing markedly from both. The pycnidial stage was referred by Cooke and Massee (1) to the genus *Ephelis*, Fries, of the order *Phomales*, under the name of *Ephelis trinitensis*, Cooke and Massee.

Balansia trinitensis has apparently never been recorded outside Trinidad, but three other species of the genus are known in other parts of the world. These are *Balansia hypoxylon* (Peck) Atk. from the United States; *Balansia Claviceps*, Speg. from South America, and *Balansia jungneri*, P. Henn. from West Africa.

The appearance of *Balansia trinitensis* on *Chaetochloa palmifolia* or *Chaetochloa sulcata* is most characteristic; the inflorescence which appears to be always totally infected is transformed into a dark purplish-black stroma covered with capitula 1-2 mm. in diameter and raised on short stalks up to 3 mm. long (Figs. 1 and 2). No cases of partial infection have been observed.

The method of infection and life history of the fungus are unknown at present; but the way in which the transformed inflorescence emerges fully formed from the last leaf sheath; and the fact that if one inflorescence on a plant is infected all the inflorescences produced on that plant are diseased; strongly suggests a perennial mycelium in the rootstock, and a systemic infection of the whole plant.

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A THREADBLIGHT OF THE TONCA BEAN.

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In the Annual Report of the Department of Agriculture of Trinidad and Tobago for 1932 (published 1933), F. Stell (1) recorded a threadblight of the Tonca bean (*Dipteryx odorata*) caused by a *Corticium sp.* which was doing considerable damage in one or two localities. In August, 1934, Tonca bean trees growing in the Las Cuevos district of Trinidad were reported to be seriously attacked by a threadblight which had practically defoliated a considerable number of ten to fifteen-year old trees. Material from these trees was sent in to this Institution and upon examination proved to be a *Marasmius sp.* The threads were rather indefinite, being covered by a sheet of white mycelium or pellicle on both stems and leaves. They were found most commonly on the lower sides of the leaves, rarely spreading to the upper side. The threads were mostly white, but on the twigs and branches the older ones had developed a light brown colour. The hyphae in the threads were fine, hyaline, rarely septate, up to 3μ in diameter, with clamp connections. The living and dead leaves and stems were often stuck together in one mass by the mycelial threads spreading between them. No fructifications were present on the material available. Pure cultures of the organism were obtained by placing small pieces of the mycelium on malt-extract agar in petri dishes, and compared with stock cultures of other Trinidad threadblights obtained in 1933. In both its general appearance and in its cultural reactions the threadblight of the Tonca bean was found to be identical with the *Marasmius* threadblight of Coffee (M2) and the *Marasmius* threadblight of grapefruit (M3) described by Briton-Jones and Baker (2).

Threadblights are external parasites and occur most commonly in the wet season under conditions of high humidity, and may often be successfully controlled by reducing the humidity. The *Marasmius* threadblight of the Tonca bean appears to be somewhat exceptional in that it occurred on a fairly open field at the beginning of the wet season after a long and severe dry season. The district where it was found is, however, one with a high rainfall, and consequently a high humidity. It is probable that this threadblight could be controlled successfully if the humidity round the trees could be further reduced in any way.

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CULTIVATION OF (*ALEURITES FORDII*) IN THE SOUTHERN SHAN STATES, BURMA.

* *Aleurites Fordii* is not indigenous to the Southern Shan States, although *A. montana*, from which Chinese wood oil is also obtained, has been found in the Mong Yawng Circle of the Kengtung State (*see* this bulletin 1924, 22, 217). The earliest attempt on record to grow *A. Fordii* in the Southern Shan States was initiated by the Imperial Institute, who in 1923 sent out a few pounds of seed of Chinese origin. It has, however, not been possible to obtain any information as to the progress of these experiments.

As regards the preparation of the land prior to transplanting the seedlings, two methods have been tried in the Southern Shan States. In certain States, the waste land is cleared and holes dug 18 ins. deep and a foot square, at a spacing of 20 ft. by 20 ft. square planting. Direct sowing as well as transplanting has been tried in these districts. Near Taunggyi the preparation of the soil is more intense and the seedlings have been grown on potato "*yas*" (shifting cultivations). In this form of cultivation, the undergrowth is cut in September, and the land is ploughed and harrowed, while the earth is still soft. In December the trees are cut, parts suitable for firewood disposed of, and the remaining branchwood, twigs, roots, &c., collected in heaps at intervals on the cleared ground. These heaps are allowed to dry and are burned in March. The soil is then raised into mounds, inside which farmyard manure is placed and burned. In April these heaps are levelled, lines roughly marked on the ground, potatoes sown in these lines, and the earth heaped up over them to form parallel raised lines. In the case of Tung, the area is staked 6 ft. by 6 ft. soon after the ground has been levelled if this tree is to be cultivated with other species or 24 ft. by 24 ft. if a pure stand is required.

Direct sowing of Tung seed cannot be relied upon, as the results depend to a great extent upon the viability of the seed sown. It is therefore preferable to plant up areas with seedlings raised in nurseries. Experiments in transplanting seedlings varying in age from one month to one year or more have been made with success. Transplanting was first tried with balls of earth, but later this method was abandoned. In most cases the seedlings have been transplanted whole, but in a few cases the plants have been cut back to a height of about 18 ins. and in one or two cases they were cut down to 2 to 3 ins., the roots also being pruned below the carrot shaped portion. All these methods have proved successful. Transplanting has been tried at different times of the year; one-month-old seedlings have been moved at the end of July during rainy weather; three-month-old plants towards the end of October and year-old transplants during the rains. The results obtained have been better than those from direct sowing, the percentage of success being over 50.

Manurial experiments were carried out in 1930, but were discontinued, as the results showed little difference between the manured and untreated plots.

When Tung is being grown in potato "*yas*," the cultivation of potatoes is carried out for two or three years in succession. In the first year no Tung seedlings are planted, these being put down in the second year. Paddy and wheat were cultivated alongside Tung in this Reserve, and from the results obtained it is concluded that it is preferable to grow wheat rather than paddy as the former is cultivated during the resting period of Tung while the paddy season coincides with its growing period. The cultivation of cover crops has not yet been tried.

Statistics relating to the growth of Tung trees in the Southern Shan States are available from 1929. At the end of each of the first four years the average height was respectively, 1 ft., 1 ft. 6 ins., 4 ft. 5 ins. and 5 ft. 5 ins. The area now under Tung is 32 acres, of which 26 acres were planted in 1929 and the remaining 6 acres in 1931.

Some of the 1929 plantations flowered for the first time in March 1932, and again early in March, 1933. Flowers appear before or at the same time as the new leaves in March and remain on the trees till about mid-April, when most of the petals fall and fruits form. They are of the usual type, one in each cluster being female, and the remainder male. The fruits ripen in September. The plants in the 1929 plantations did not all flower, and so far 24 acres, containing 1,480 trees, have yielded only 108 fruits. These fruits have been examined at the Forest Research Institute, Dehra Dun, and were found to contain 46.5 per cent. of oil in the kernels. This oil content is below the average (56 per cent.) for Chinese kernels.—(*Bulletin of the Imperial Inst.*, Vol. XXXII, No. 1, 1934, pp. 133-136.)

* A full account of these experiments may be found in the *Indian Forester* 1933, 59, 560-571.

A NOTE ON THE SOWING OF GREEN MANURE CROPS.

By R. Cecil Wood, M.A., and A. D. Herbert, Dip. I.C.T.A.
(*Imperial College of Tropical Agriculture*).

Attention has been drawn previously by the senior author (1) to the question of the provision of, and the necessity for economy in the use of seed for green manure crops. Experience on the College Farm of the Imperial College of Tropical Agriculture has indicated the benefits that may be obtained from sowing *by hand*, such large sized seed as *Canavalia* spp. and *Stizolobium* spp., which run from 300 to 600 to the pound (2). It is of course a matter of the relative cost of the seed and the labour necessary to sow it, and the object of this note is to indicate the probability that in many cases considerable economy will be effected.

I.—Cost of Seed.

Canavalia is the cheaper, but it is not such a thick smother crop as *Stizolobium*. The latter will not set seed abundantly unless it is propped in some way, and this adds to the cost. Experience here indicates that 800 lb. an acre of *Stizolobium aterrimum* may be obtained at a cost of 80 man-days, or about $30.00. Another $20.00 must be added for props, manures and supervision, making $50.00 in all, which works out at over 3*d*. a pound. *Canavalia* will be rather less.

II.—Cost of Planting by Hand.

The technique adopted here is to range a line of women or children up to an old 100 ft. survey chain, marked at the requisite intervals with tags of cloth. The line is moved on a specific distance by a man at each end, and each planter is responsible for two or three holes. In this way, the cost of planting an acre is the wages of four to six women per acre, depending on the state of the land and the distance of the planting. The amount of seed used, putting in two seeds a hole, should be for *Stizolobium* 72 lb. an acre for one foot by two feet spacing, and 36 lb. per acre if put out two feet by two feet. *Canavalia* will need about twice these quantities, but may be planted one seed to a hole. The actual amounts reported to have been used here are given below.

Field.	Crop.	Spacing.	Seed rate per acre in lb.	Remarks.
4	Stizolobium	2′ x 3′	30	A few pounds extra use for filling. Two seeds a hole.
6	do.	2′ x 1′	41	One seed a hole
16	do.	2′ x 2′	40	Two seeds a hole
27D	do.	2′ x 1′	39	One seed a hole
23	Canavalia	2′ x 2′	42	One seed mostly: small portion planted two seeds a hole.

The alternative to planting by hand in this way, is either to drill or to broadcast. Using a single-row planter drawn by a mule, the following figures are obtained for seed-rate :—

Field	Crop.	Spacing.	Seed rate per acre.	Remarks.
27A	Stizolobium	3′ rows	63 lb.	Land dirty : thick-sowing Plate with 8 holes.
29	do.	3′ rows	35 lb.	Land clean: thin-sowing Plate with 6 holes.

For broadcasting, it is customary to allow from 100 to 150 lb. an acre for either of these crops. It may accordingly be taken that hand-planting will save about 30 lb. an acre (see 27D and 27A) over drilling, while it may save anything up to 100 lb. an acre over broadcasting, a saving which is worth 7*s*. 6*d*. in one case and 25*s*. in the other. Against this there is the cost of the extra labour, equivalent to the wages of say five women days.

There are, however, other advantages in hand sowing, besides the economy of seed. It will often be the case that the crop is being planted on particularly weedy land, with the object of smothering the weeds, and consequently the question of weeding is one of importance. A crop planted by hand is check-rowed, and can be intercultivated in two directions, if not in the diagonals as well. Even if animal-drawn intercultivating implements are not available, hand weeding is more quickly and more efficiently performed in such a regularly spaced crop.

References

1. R. Cecil Wood.—*Agricultural Journal of British Guiana*. I, 221.
2. Agricultural Note Book. R. Cecil Wood.

PINEAPPLES.

In a recent display of pineapples from South Africa, the Azores and Porto Rico, and smaller quantities from Nigeria and Brazil, some of the Azores pineapples arrived in a novel form of package on which the trade reported favourably. Each fruit was in a cellophane wrapper secured by the metal seal of the grower, and embedded in wood-wool, and each was in a separate light wooden case. There was printed matter with each, including medical opinion on the advantage to health of eating the pineapple, and a request to doctors to try it on their patients.

REVIEWS.

An Introduction to Plant Biochemistry.

By Dr. Catharine C. Steele. *G. Bell and Sons, Ltd.*, London, 1934, pp. 356. Price 15*s*.

The aim of this new book on the chemistry of plants is to provide students of Botany with information regarding the nature and relationships of the chemical substances manufactured by plants. The text is divided into sections dealing respectively with fats, carbohydrates, acids, proteins and aromatic compounds, which is the conventional, but perhaps the most satisfactory, way of presenting the facts of plant biochemistry. Chemical transformations involved in plant processes (photosynthesis, respiration, enzyme action and metabolism) are considered in a final section. The logical treatment aims at making the book useful to students who have had no systematic training in organic chemistry. Directions for the performance of simple illustrative experiments are interspersed in the text, and a selected short list of references and a good index complete the volume.

As an introductory course, this book can be strongly recommended to students of tropical crop products manufacture, since it contains most of the information necessary for a thorough understanding of the transformations that ensue when plant materials are subjected to the different treatments employed for their stabilisation or the isolation of specific chemical compounds that occur in them.

F. H.

* * *

The Culture and Marketing of Tea.

By C. R. Harler, Ph.D., B.Sc., F.I.C., F.R.Met.Soc. *Oxford Univ. Press*, pp. 384. Price 12*s*. 6*d*.

This new book on tea is the outcome of the author's 14 years' experience as a scientist to the Indian Tea Association at Tocklai, Assam, which involved, in addition, visits to the tea gardens of Assam and Bengal with the object of disseminating amongst practical men the scientific findings of the Association. This task of linking theory with practice Dr. Harler has now commendably extended to a much wider public, though the subject matter of his book will be found useful to many others besides growers. In covering such a broad field of knowledge, it is indeed matter for conjecture whether this treatise, though not intended to be exhaustive, will find so ready an acceptance amongst planters as amongst students of agricultural economics.

The first part, dealing with the tea plant and its culture, seems the least convincing of the four sections comprising the book; to the grower there are several aspects which might well have received fuller treatment, whilst to the student a scarcity of references to literature, not noticeable in the remainder of the book, may be found disappointing. The remaining sections deal consecutively with the Chemistry and Pharmacology of tea, the tea countries of the world—in which methods of cultivation and preparation are contrasted—and finally two short chapters on the British tea trade. Each subject receives adequate and in some cases full consideration, but to the student an aspect in need of greater stress is the desirability of better co-operation between chemist and botanist or agriculturist, with a view to putting selection and planting practice on a chemical instead of the present empirical basis.

The author has presented his material in clear, readable language with well-tilted paragraphs, and his qualifications are sufficient guarantee for the soundness of the mine of information he provides. The suggestion is made that citations of literature might to better advantage be grouped at the end of sections or chapters, instead of being placed at the bottom of the page where the reference occurs.

N. W.

* * *

The Katamorphism of Igneous Rocks under Humid Tropical Conditions.

By the late Prof. Sir J. B. Harrison. *Imperial Bureau of Soil Science*, Rothamsted, England, 1934. Pages 1-79, Tables i-lviii. Price 5*s*.

This book contains an account of the exhaustive chemical and mineralogical studies of rock-weathering and soil-formation in British Guiana, South America, undertaken by the late Director of the Department of Science and Agriculture of British Guiana, during his 37 years of residence in the Colony. In a Foreword, Sir John Russell, Director of the Rothamsted Experimental Station, explains how the book came into being, through the discovery of the manuscript among the archives of Prof. Harrison's department, and the generous financial aid to the printing afforded by the British Association for the Advancement of Science and by the Demerara Proprietors. The revision of the manuscript is the work of Prof. F. Hardy, of the Imperial College of Tropical Agriculture, Trinidad. In the Preface, Prof. Hardy outlines the scope of the work and its main conclusions.

Harrison's contribution to the science of the soil lies mainly in his insistence on detailed chemical analyses of thin layers of the materials progressively formed during the alteration, weathering and leaching of the minerals comprising the parent rock. The "profile" is investigated from below upwards to the final surface soil. This method enabled Harrison to explain the process known as "lateritisation," which is so common in the humid tropics, and clearly to differentiate between the contrasted products that distinguish the transformation of the more basic igneous rocks from the changes that affect acidic igneous rocks in humid climates. He showed that,

whereas basic rocks generally undergo lateritisation, frequently followed by resilication that give rise to deep layers of "red earth", acidic rocks (such as granite) yield no such product, but are generally transformed directly to white pot-clays and siliceous sands. These fundamental differences may affect the nature of the surface soil overlying the contrasted types of parent igneous rock material, although heavy downward leaching by rain water may "level up" the composition and properties of the final superficial product. The bearing of these findings on questions of soil fertility in the humid tropics is considerable.

During his researches, Harrison paid particular attention to the problem of bauxite formation, and his methods and conclusions should prove of great value to mining geologists concerned in the commercial exploitation of this valuable aluminous ore.

F. H.

CONTROL OF THE WEED *CLIDEMIA HIRTA* IN FIJI BY *LIOTHRIPS URICHI* FROM TRINIDAD.

It is interesting news when a noxious weed is brought under control by introduced insects. The method is at present more novel than the control of insect pests by biological means, and it is an even more exciting game, because of the extra risk involved in transporting plant-feeding insects. A recent success is well described by H. W. Simmonds (1) on "The Biological Control of the Weed *Clidemia hirta*, D. Don., in Fiji" by the thrips, *Liothrips urichi* Karny, introduced from Trinidad in 1930. Biological control has been practised with great vigour in Fiji, where in the campaign against the *Levuana* moth on coconuts it made one of its most rapid and striking conquests. The case under review is of special interest to the Imperial College of Tropical Agriculture, because of its part in the preliminary work in Trinidad.

Clidemia hirta is a melostomaceous shrub, native in the West Indies, Central America and northern South America. It was accidentally imported to Fiji prior to 1890 and, according to Simmonds' observations on the slight variations in its foliage in different countries, probably came from British Guiana. Of little economic importance in the New World, it took possession of thousands of acres in Fiji, forming stands up to six feet high on good soil, and causing some loss in crops and expense in weeding. Its spread was hastened by fruit-eating birds, notably the Indian mynah—whose nefarious habits in many Pacific islands show the danger of transporting birds, especially species so aggressive as the mynah, from one country to another.

Because of the attention drawn to the weed in Fiji, specimens were planted for observation at the St. Clair Experiment Station, in Trinidad, and on these F. W. Urich found the thrips that now bears his name. It feeds especially on young leaves and stems, sometimes causing the shoots to wither and die. T. H. C. Taylor (2), visiting Trinidad from Fiji in 1927, saw the possibility of using this insect, and the problem was investigated for the government of Fiji by post-graduate students at the Imperial College. Of these W. Cook (3) undertook the important work of testing the thrips on some twenty species of crop-plants, and concluded that it was specific for *C. hirta* as host. It was not found in the field even on other species of the genus *Clidemia*. Its introduction to Fiji was therefore thought to be safe (despite the injurious habits of other members of the genus *Liothrips*), and in 1930 a large shipment was taken to Fiji by Simmonds. He also studied some of the many other insects that feed on *Clidemia* in Trinidad, and this work was continued by F. Squire and E. Parry-Jones, students at the Imperial College in 1930-31. So far it has not been necessary to introduce any of these insects to Fiji, but it is interesting to note that the *Liothrips* is not the most important among the insect enemies of *Clidemia* in Trinidad.

The thrips were shipped to Fiji on living plants in large cages. The important work of eliminating parasites was done, apparently successfully, in Fiji. About 20,000 adult thrips were obtained and some of them were immediately liberated, in March 1930. In that year drought hindered their spread, but in 1931 they began to control the weed, not by killing it directly, but by weakening it to the advantage of its competitors. Simmonds writes that "by August, 1932, some 27 months after liberation, many hundreds of acres which had been a sea of the weed six feet high were, on Taveuni, changed to a vast area of *Micania* . . . with here and there a few shoots [of *Clidemia*] showing but not producing seed", and that "the thrips can be definitely said to have brought the weed under control over large areas". His prediction for the future is a balance in which any outbreak of the weed will be controlled by increase of the thrips.

An interesting part of the story is the change, in the new habitat, whereby the thrips has become much more efficient in destroying the weed than in their native countries—which is a good illustration of the almost unlimited possibilities in the use of animals in biological control.

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1. Simmonds, H.W., 1933.—*Bull. Ent. Res.*, xxiv, 3, pp. 345-8.
2. Taylor, T. H. C., 1928.—[Report on investigations in Trinidad on *Liothrips urichi* as a parasite for *Clidemia hirta*.] *Legis. Council Paper*, Fiji, 5, pp.
3. Cook, W., 1929.—Some feeding experiments undertaken in Trinidad with *Liothrips urichi* (Karny). *Agric. Journ.*, Fiji, II, 4, pp. 85-92.

A. M. A.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Micro-Organisms and Raw Sugar Deterioration.—*By A. F. Bell and P. J. Staunton.*

The average time elapsing between the manufacture of Queensland raw sugar and its analysis by overseas refiners is about three months, the deterioration of sugars which upon arrival exceed the moisture safety factor is from 0.5 to 3 units of net titre, if not more. The chief weapon (aside from maintenance of a safety factor) against this loss is avoidance of contamination of the sugar with micro-organisms, because the degree of deterioration is probably in some measure proportional to the degree of initial infection (*i.e.*, number of organisms present in the finished sugar). Most bacteria are killed by 10 minutes' exposure to a temperature of 140°F., and even the thermophiles cannot increase if a temperature of 160°F. is maintained during the manufacturing processes. However, it is practically impossible to manufacture a sterile raw sugar, and for complete safety the moisture content must be kept down. For many years it has been assumed that when the value of the expression $\frac{\text{Moisture}}{100-\text{Pol}}$ exceeded 0.333 the limit of safety had been passed, but latterly a new formula has been introduced which is thought to represent the facts more accurately. This formula (the so-called 'dilution indicator') is $\frac{100 \times \%\ H_2O \text{ in Sugar.}}{100 - \text{pol} - \%\ H_2O}$ If the value of this expression is 50 or less, the sugar is considered safe. The point of this new formula is that if the moisture increases, the value of the quotient increases in larger proportion, which is a truer measure of the increased liability to deterioration. —(*Facts About Sugar*, Vol. XXIX, No. 8, 1934, pp. 280-81.)

* *

Ash Constituents of the Cane and Raw Juice.—*P. Honig.*

In this **mededeeling* an account is given of investigations into the way in which the ash content of the cane, *e.g.* POJ 2878 may vary in various parts of Java. It appears from the numerous tables given in it that for the determination of the amount of K_2O and P_2O_5 taken up, an analysis of the raw juice suffices to obtain an approximate idea of the quantity of these constituents removed by the plant from the soil; but that to obtain an exact insight into their amount taken up per unit of area it is necessary that the cane should be sampled with care, and that its weight should be precisely known.

The quantity of SO_3 present in the plant is for the greater part concentrated in the juice; but in examining the amounts of Ca and Mg it is of importance that besides the juice, the bagasse, and also the cane leaf, should be analysed. In some cases the alkali-earths in the juice amount only to 30 to 50 per cent. of these present in the whole amount of the plant, the actual amount depending upon the ripeness of the cane. In the table given below are summarised: (A) the total quantity of ash constituents in grams. per plant: and (B) the amounts present in the cane juice, as a percentage of the whole.

It appears from these figures that there is a specific connexion between the quantities of K_2O, CaO, MgO and P_2O_5 present in the plant and that which may be found in the raw juice. In order accurately to determine the quantity of the nutrient constituent taken up by the cane plant, one must if exact indications are to be obtained, estimate the number of stalks per acre and also the average weight of the stalk and leaf, and further determine the average composition of the stalk, raw juice and bagasse. It is not necessary that ripe cane should be used, since the ash absorption after the 9th to the 11th month is practically at a standstill.

It is finally emphasized that the figures given relate to the year 1931, as it appears that the absorption of soil constituents varies so much under climatic conditions from year to year, besides being very dependent upon the variety. This is borne out by comparison of the figures obtained in this investigation with similar ones published by others in other countries.—(*Int. Sugar Jr.*, Vol. 36, No. 429 pp. 361-62, 1934.)

	K_2O		CaO		MgO		P_2O_5	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
Wringinanom ..	7-9	60-70	0.45-0.60	40-50	0.55-0.70	50-65	1.60-2.20	70-85
Semboro	7.5-9	70-80	0.30-0.45	30-50	0.25-0.35	50-60	0.65-0.75	55-75
Winongan	7.2-8.0	70-80	0.40-0.55	35-40	0.50-0.60	40-65	1.200-1.3	70-85
Meritjan	4.5-7.0	35-65	0.50-0.65	30-50	0.65-0.75	50-60	0.70-1.35	40-80
Modjo	3.5-5.0	50-60	0.55-0.65	40-50	0.65-0.75	55-65	0.50-0.65	40-30
Klampok	1.5-4.0	40-65	0.30-0.60	40-50	1.35-0.70	45-65	0.40-0.65	50-65
Kalimati	0.8-1.4	30-40	0.45-0.65	35-45	0.85-1.00	60-70	0.55-0.65	50-80

* *Archief*, deel II, meded. 1934. No. 10, pp. 435-524.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Coffee Fat.

The composition of the fatty oil obtained by extraction from natural raw coffee bean, freshly roasted bean, and stale roasted bean has recently been examined by Messrs. R. O. Bengis and R. J. Anderson (*Journ. Biol. Chem.*, 1934, p. 139). The results show that no appreciable loss or alteration of the fat follows roasting or ageing. Nevertheless, the characteristic coffee odour of the freshly roasted fat slowly disappears on standing, and is replaced by an unpleasant, rancid smell.

The fatty acids of coffee fat include about 53 per cent. of the unsaturated acids, oleic and linolic acids, in approximately equal amounts. The saturated fatty acids present (47 per cent.) chiefly comprise palmitic acid, with a small amount of stearic acid. The following data refer to analyses of typical samples.

	Raw Beans.	Freshly Roasted Beans.	Stale Roasted Beans.
Extractable Fat (per cent.) ..	81.1	90.4	86.3
Saponification value ..	179.3	172.1	171.9
Iodine number	97.8	96.0	95.6
Unsaponifiable matter (per cent.) ..	9.0	10.2	9.6
Phosphatide content (per cent.) ..	0.10	0.08	0.21

* * *

Soil Requirements of Tea.

That the tea-bush thrives on soil that is often highly acidic is well known, but H. H. Mann, in the *Empire Journal of Experimental Agriculture*, Vol. I, 1933, p. 245, shows however, that it requires some lime, although suitable soils usually contain less than 0.15 per cent. of lime soluble in hydrochloric acid. The lime should not occur as calcium carbonate, as this produces alkalinity, whereas the tea-bush cannot withstand conditions more alkaline than pH 5.6 to 5.8. Soil alkalinity causes stunting of the main stem, crowding of leaf-buds and early leaf-shedding. It also prevents the development of the tap-root, and causes the concentration of laterals near the injured end.

The nitrogen requirements of the tea plants are large, but excess of nitrogen may be disastrous, in that it seriously diminishes the quality of the manufactured tea. If more than 40 pounds of available nitrogen per acre are supplied, the quality of the tea may be adversely affected, unless, perhaps, potash and phosphate are supplied in addition. Phosphate appears to affect tea quality also, although sufficient evidence has not yet been accumulated to enable this generalisation to be universally applied. Potash minimises fungus damage, and prolongs the growing period of the tea-bush, so that a supply of leaf is maintained at the end of the producing season. Potash added to the soil appears also to enable the tea plant to withstand attack by certain insects, notably the mosquito bug, and the ratio of available potash to available phosphate in the soil in many cases furnishes a reliable index of susceptibility to injury by this pest.

With respect to the less-abundant soil elements, both manganese and magnesium compounds have been attributed with the ability to improve tea quality, but the evidence is not conclusive. On the other hand, sulphur deficiency has been recently proved in Nyasaland to give rise to a specific physiological affection of tea known as 'tea yellows', which can easily be cured by manuring with sulphur or sulphates, such as the soluble sulphates of ammonia, potash or magnesia.

* * *

The Mitscherlich Method in Hawaii. *D. A. Cooke, et al.*

Agreement between the results from the Mitscherlich pots and the results of field tests is very good. Planters are now able to determine the fertilizer programmes with what amounts to practical certainty, both as regards the use or the omission of a given fertilizing element on a certain field.

Many fields to which it has been the custom to apply potash and phosphate have been proved by the Mitscherlich method to contain large quantities of these elements; large savings may therefore be made by discontinuing the practice for the time being. On the other hand, the test has shown with equal positiveness the deficiency of these elements in other fields. Sudan grass is chiefly used as the indicator plant, though others, as buckwheat, Guam corn or sorghum, might serve.—(*Inter. Sugar Jour.*, Vol. XXXVI, No. 426, 1934, p. 241.)

* * *

Effects of Manures on the Root System of Maize.

The anchorage of maize plants by the development of a suitable strong root system is an important factor in conferring resistance to wind damage. Recent experiments by H. A. Pettinger (*Virginia Agric. Expt. Stat., Tech. Bull.* 46, 1933), have shown that root anchorage is markedly increased by the addition of nitrogenous manures to nitrogen-deficient soils, provided sufficient potash is present, but is diminished if potash is lacking. Both phosphate and potash increased root anchorage of maize in soils deficient in these nutrients, their action being even more marked than that of nitrogen. On the other hand, rainfall proved to be the most important of all factors controlling root anchorage, and far outweighed the effects of systems of manuring or of cropping.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows:—(c.i.f. per cwt.)

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
23rd August	4	9¾	8	5¼
30th August	4	9¾	8	5½
6th September	4	9¾	8	5¼
13th September	4	5½	8	3
20th September	4	5¼	8	1½
27th September	4	5¼	8	2¼
4th October	4	5¼	8	4½
11th October	4	5¼	8	4½
(*12th Oct.*, 1933)	4	11¼	9	10½

Business in raws has generally continued to be very moderate. The futures market after showing a weaker tendency has latterly developed a firmer undertone but prices, on balance, have been lower. Dr. Mikusch's first estimate of the 1934 European beet crop, including Russia indicated a yield of 6,394,000 tons raw value, compared with 6,156,000 in 1933.

* * *

COCOA.—Within the past month a litte stir was created in the Accra market by a report that the farmers on the Coast were considering a "hold up" but this report was unfounded and thus it seems unikely that there will be any means of bringing prices to higher levels, with such ample supplies of cocoa and good crop prospects. Accra cocoa is quoted at 19*s.* 6*d.* c.i.f. and locally $6.60 a fanega is paid for plantation cocoa.—*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*

* * *

BANANAS.—The demand has been affected by the large offerings of plums, apples and other fruit. The price of Jamaicas is unchanged at £18 5*s.* per ton delivered London and £18 nearest station Provinces. Brazilians are also unchanged at £18 per ton.—(*West India Committee Circular*, 13th September.)

* * *

LIME PRODUCTS.—*Lime Oil.*—There is very little Handpressed offering; the value is nominally 35*s.* per lb., Sellers of Distilled are asking 20*s.* for spot oil. *Lime Juice.* There are buyers of Concentrated at £4 15s. Raw is quiet but steady at 2*s.* 3*d.* to 2*s.* 6*d.* per gallon.—(*West India Committee Circular*, 13th September.)

* * *

COPRA.—The value of West Indian f.m.s. for October shipment is £9 7*s.* 6*d.* c.i.f. The market is very quiet.—(*West India Committee Circular*, 13th September.)

RUBBER.—Quotations for Plantation Sheet have ranged as follows:—

	d.
22nd August	7 5-8
29th August	7 9-16
5th September	7 1-2
12th September	7 1-2
19th September	7 3-8
26th September	7 7-16
3rd October	6 15-16
10th October	7
(*11th Oct.*, 1933)	4 1-32

Since our last report prices have shown a slight tendency to sag. News that the Siamese Government had refused to ratify the Rubber Control Scheme came as a shock to the market, values being written down at one time about 5-16*d.* per lb. A partial recovery, however, followed later and it is generally believed that the difficulty will be overcome. Consumption figures at 44,939 tons for August and at 510,000 tons for January-June are considered better than was anticipated.

* * *

COFFEE.—The market has generally been slow. The following price ranges per cwt. are recorded. Blue Mountain Jamaica, Bold 210*s.* to 226*s.*; 2nd sizes 168*s.* 6*d.* to 196*s.* and 3rd sizes 156*s.* to 177*s.* 6*d.*; Kenya 62*s.* to 83*s.*

* * *

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian F.G.F. Sakel.*
24th August	7.12	8.77
31st August	7.11	8.74
7th September	7.20	8.75
14th September	7.10	8.32
21st September	7.05	—
28th September	6.96	—
5th October	6.87	—
13th October	6.94	—
(*13th Oct.*, 1933)	5.44	7.16

Prices have shown further easiness and business in actual cotton has generally remained quiet. The situation is complicated by the United States textile strike while some disappointment was caused by the Bureau estimate which showed an increase of 57,000 bales instead of an anticipated decrease of 200,000 bales. Only moderate business has been done in West Indian cotton, prices ranging from 7½*d.* to 15½*d.*